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ABSTRACT

This guide, part of a series of workplace-developed materials for retraining factory workers, provides teaching materials for a workplace mathematics course. The course is a review of basic number concepts focused on helping participants to understand the meaning of numbers and arithmetic operations. The introductory materials include a course outline, course objectives, a topical outline, information on course length and continuing education units, and resources. Lesson plans for 12 sessions are provided on the following topics: math anxiety, place value, multiplication and division tips, addition and subtraction shortcuts, problem solving, whole number operations, rounding, estimation, decimal operations, decimals in job-related situations, decimal applications, tolerance, radius and diameter, fractions and mixed numbers, converting fractions to decimals, reading a fractional inch scale, screw measurement, metric and English systems, percents, graphs, charts, paychecks, benefits, ratio and proportion. The session materials include objectives, topics, methods, evaluation criteria, a pretest and a posttest, information sheets, and handouts. (KC)

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ED 388 793

MERCER COUNTY COMMUNITY COLLEGE

TRENTON • NEW JERSEY

Math on the Job

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PEOPLE RETRAINING for INDUSTRY EXCELLENCE

CE 070 177

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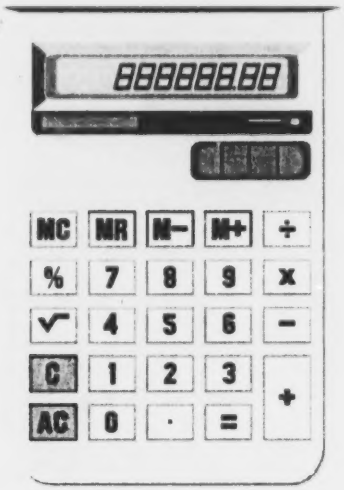
Math on the Job



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Elaine S. Weinberg
Director, Workplace Skills

United States Department of Education
National Workplace Literacy Program
1995

ACKNOWLEDGMENT

Mercer County Community College thanks Jean Meier, Senior Education Specialist/Curriculum Developer for creating this manual. Through her valuable contributions employees in manufacturing and service industries learned concepts relevant to their existing jobs and strategies for learning other tasks if that opportunity should arise.

WORKPLACE SKILLS TRAINING PHILOSOPHY

A factory or service center creates a classroom that is very different from the one we are used to seeing in colleges and adult schools, so it only follows that our approach to teaching in the factory should also differ.

Our goal is to teach employees skills that they need in order to be functional and successful in their work environment, and encourage them to apply those skills on the job and at home. For example, we motivate students to do the following:

- work more efficiently and more safely
- make fewer mistakes
- solve problems working interactively
- take greater responsibility for their jobs
- recognize the interconnectedness of the various jobs in their workplace
- be better communicators in the workplace

Company needs are revealed through a needs assessment. At that time, we also determine the basic skills needs of the employees. We are learner centered, as the individual employee's needs are considered alongside those of the company.

Once we have determined those needs, we develop curricula that incorporate basic skills, using the workplace literature (e.g. forms, applications, codes, abbreviations, charts and tables, handbooks, regulations, procedures, policies, memos, letters) of the company. Because each company is different, the needs and literature are also different; hence, we develop new materials for every company in which we teach. By utilizing these workplace items, we help students transfer and apply their skills directly to their jobs.

We rely on the classroom techniques of problem solving, cooperative learning, and group discussion. Our overall approach is concept based, with the emphasis on application, such as in role plays, dialogues, and group work. Despite the specific course titles, we incorporate the elements of math, English, and communication skills into all of our sessions.

In terms of students evaluation, after initial testing we give a pre-test and post-test in order to determine comprehension. Students receive feedback throughout the course from the instructor, as well as from fellow students as we sincerely believe in the powerful positive reinforcement of peer critiques and cooperative exchanges.

In essence, we believe that although we make the materials for the students with which to work, it is the students who truly make the class.

MATH ON THE JOB

COURSE OUTLINE:

This course is a review of basic number concepts focused on helping participants understand the meaning of numbers and arithmetic operations. Strategies are provided for increasing accuracy when doing computations with whole numbers, decimals and fractions. Reading charts and graphs will be covered together with weights and measures. Applications to real work situations are used throughout with an emphasis on problem solving.

OBJECTIVES:

Upon completion of this course, students will be able to:

- read and write whole numbers and decimals using a place value chart
- perform operations involving whole numbers, decimals and fractions
- apply number concepts in problem solving situations
- read a fractional inch ruler
- convert English units of measurement
- calculate tolerance limits

TOPICAL OUTLINE:

- place value
- computations with whole numbers
- computations with decimals
- understanding fractions
- understanding per cents
- problem solving
- measurement

MATH ON THE JOB

OTHER:

- Hours: 24
- CEU: 2.4

SOURCES:

Mitchell, Robert. **Math Skills that Work, Book One.** Chicago: Contemporary Books, 1991.

MATH ON THE JOB

COURSE OUTLINE

Session 1

- Pretest
- Math Anxiety
- Place value with whole numbers and decimals

Session 2

- Multiplication and division tips
- Addition and subtraction shortcuts
- Problem solving on the job
- Operations with whole numbers

Session 3

- Rounding
- Estimation

Session 4

- Operations with decimals
- Using decimals in job related situations
- Applications of decimals

Session 5

- Tolerance
- Radius and diameter

Session 6

- Understanding fractions and mixed numbers
- Converting fractions to decimals

COURSE OUTLINE (CON'T)

Session 7

- Reading a fractional inch scale
- Screw measurement
- Drill bits

Session 8

- Measurements
- Converting inches to feet

Session 9

- Metric System
- English System

Session 10

- Per cents
- Graphs and Charts

Session 11

- Pay check
- Employee benefits
- Job labor cards
- Decimal time

Session 12

- Ratio and proportion
- Direct mail estimate
- Job estimate
- Post test

MATH ON THE JOB ♦ SESSION I

OBJECTIVES:

Upon completion of this session, students will be able to:

- assess their level of math anxiety
- discuss the meaning and appropriate use of different types of numbers
- read and write whole numbers and decimals using a place value chart
- assess current level of math understanding

TOPICS:

- math anxiety
- the appropriate use of different types of numbers in different contexts
- place value

METHOD:

- administration of a pretest
- complete math anxiety self assessment
- complete *Place Value* handout

EVALUATION:

- self evaluation based on discussion of the work sheets
- pretest will be administered and graded so that progress can be assessed upon completion of the course

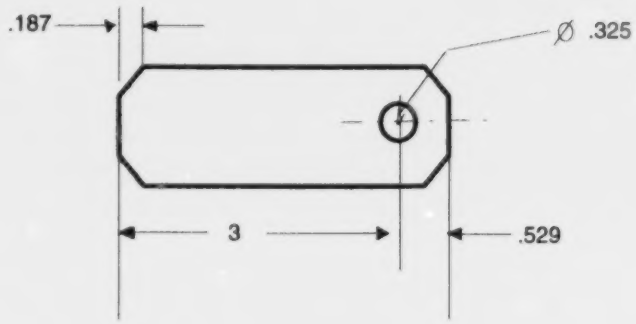
MATERIALS:

- handouts: Math Anxiety
  Place Value
- pretest

MATH ON THE JOB ♦ PRETEST

1. What is the overall length of the plate illustrated?

   (Ø .325 means diameter .325) All measurements are in inches.



2. Add: 125 and 23.63 and 8.731

3. You are assembling 60 units. The work order calls for a total of 99.96 total feet of shrink tubing. How many feet per unit?

4. In the number 39.1852 what place is the 8 in?

   a. tenths b. hundredths c. thousandths d. ones

MATH ON THE JOB • PRETEST

5. A pallet is being loaded by an operator with his stampings which weigh 5.2 pounds each. How many can the operator stack on the pallet if he has a weight limit of 600 pounds?

_____

6. Write $1\frac{3}{4}$ and $\frac{7}{12}$ as a decimal.

_____

_____

7. A role of sheet metal runs through a press at 35 ft./min. How much will be used in 2 hours?

_____

8. Change the following measurements to inches:

   - 1.25 feet _____
   - .57 feet _____

9. In one seven and a half hour day 4000 parts were made. How many parts per hour is that?

_____

MATH ON THE JOB • PRETEST

10. Calculate 600,000 + 20,000.

_____

11. Which of the following would be measured with units of square feet?

heat shrink tubing packing pad sound foam ground wire

_____

12. Subtract: $20 – $.15

_____

13. Which number is larger in each pair?

1.5 or 1.50 .3 or .09

_____

14. Divide: 518 + 5

_____

15. Express the following improper fraction as a mixed number.

$\frac{75}{4}$ =

_____

MATH ON THE JOB • PRETEST

16. Express the following fraction as a fraction in lowest terms.

$\frac{30}{32}$ = _____

17. Write each of the following numbers as words.

- 0.6 _____
- 0.147 _____

18. Write the following number: three hundredths

_____

19. Round each of the following numbers to the indicated number of decimal places.

- 0.596 (hundredths) _____
- 0.80729 (thousandths) _____

20. Multiply or divide each of the following values. Round the answer to the hundredth place where necessary.

- 12.3 X 0.6 _____
- 24 + 0.48 _____

MATH ON THE JOB ◆ PRETEST

21. If the diameter of a hole is 2.1 inches then the radius is?

_____

22. A blueprint indicates tolerance as given. Determine the maximum dimension (upper limit) and the minimum dimension (lower limit) for each. Express your answer as a decimal in both cases.

1.714	±	0.005	=
18	±	$\frac{1}{64}$	=

_____

23. Read the measurements A-C on the enlarged fractional rule shown.

A. _____

B. _____

C. _____

MATH ANXIETY

Self Assessment/ Self Awareness Inventory

Please respond to the following statements on a scale from 1 to 5.

Not like Me	*Somewhat Like Me*	*Occasionally Like Me*	*Usually Like Me*	*Very Much Like Me*
1	**2**	**3**	**4**	**5**

1. Other people usually think of me as being good with numbers.
2. When doing arithmetic I usually feel confident I'll do it right.
3. Everyone around me understands more about math than I do.
4. I ask a lot of questions when I don't understand something to do with numbers.
5. I would rather have a job that didn't require any arithmetic.
6. Learning math means learning rules that I don't understand.
7. I'm scared that others will find out that I really don't know how to calculate things that I should be able to.
8. I feel sure I can learn how to do arithmetic if someone explains it to me.
9. My ways of working out math problems are different than the methods most everyone else uses.
10. I enjoy explaining to others who are new on the job how to do all the necessary calculations.

☺ What's your best experience in a math class?

☹ What's your worst experience in a math class?

If you were better at math what would you do that you don't do now?

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PLACE VALUE

Our number system is called a *decimal* number system. The prefix *deci-* means ten.

hundreds	tens	ones	tenths	hundredths	thousandths	
1	0	0				one hundred
	1	0				one ten
		1				one whole
			.1			one tenth
			.0	1		one hundredth

How many hundreds in the following numbers? How many left over?

2,100 1,000

5,120 17,543

How many 10's in the following numbers? How many left over?

5,000 40

2,670 34,600

How many 25's in the following numbers?

100 400

900 830

PLACE VALUE

Fill in the names of each place in the place value chart below:

____ ____ ____ ____ ____ ____ ____ ____ . ____ ____

Write the following numbers:

- thirty-seven million, four hundred two
- five hundred seven thousand
- fifty-seven thousand
- 8.5 million
- five billion, twenty-four million, fifty-two
- 4 trillion dollars

If you made a yearly salary of $100,000 how long would it take you to earn 4 trillion dollars?

How many 100's in the following numbers?

- 10,000
- 4,000
- 900
- 1,830
- 90,010
- 2,100
- 500,000

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MATH ON THE JOB ♦ SESSION 2

OBJECTIVES:

Upon completion of this session, students will be able to:

- use addition and subtraction short cuts
- use multiplication tips to speed mental arithmetic
- multiply by 10, 100, 1000

TOPICS:

- addition short cuts
- multiplication tips
- problem solving on the job

METHOD:

- discussion of worksheets
- groupwork

EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts: Addition/Subtraction Short Cuts
  Multiplication Tips
  Problem Solving
  Dividing Number Ending in Zero
  Multiplication/Division
  Math on the Job

ADDITION/SUBTRACTION SHORT CUTS

Often it is necessary to quickly add or subtract numbers in your head when estimating or checking to see if quantities are about what they should be.

Add numbers in groups that add to ten, a hundred or a thousand

Example:

Add: 400 + 900 + 600 + 100

Think: 100 + 1000 =

When subtracting work backwards

Example:

Subtract: 100 – 88

Think: 88 + ?? = 100

Therefore: 100 – 88 = 12

Round numbers off then adjust the answer up or down if necessary.

Example:

Subtract: 697 – 88

Think: 700 – 88 = 612

Therefore: 697 – 88 = 609

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MULTIPLICATION TIPS FOR WHOLE NUMBERS

Numbers ending in zero are the easiest to multiply

To multiply numbers that end in zero:

- **First, multiply the non-zero digits**
- **Second, follow the answer with the number of zeros in the two numbers**

Example: 2,300 X 20 = ?
23 X 2 = 46
Therefore, 2,300 X 20 = 46,000
(3 zeros total) (3 zeros)

Example: 45 X 100 = ?
45 X 1 = 45
45 X 100 = 4500

Multiplying by 5 becomes easier if you remember that 5 is half of 10

To multiply by five:

- **First, multiply by 10**
- **Take half of your answer**

Example: 5 X 42 = ?
Think: 10 X 42 = 420
Therefore 5 X 42 = 210

You will get the same answer no matter in what *order* you multiply the numbers.

Example: Try both of the following problems. Which is easier to do?

5 X 7 X 8 =

5 X 8 X 7 =

MULTIPLICATION TIPS

Sometimes breaking numbers down into their parts before you multiply helps to make the problem easier.

- **Break down using *multiplication***

  Example: 15 X 22 = ?

  Think: 3 X 5 X 2 X 11

  33 X 10

  330

- **Break down using *addition***

  Example: 15 X 80 = ?

  Think: (10 + 5) X 80

  10 X 80 + 5 X 80

  800 + 400

  1200

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PROBLEM SOLVING

Problem solving often requires one operation or a combination of operations. You must decide which operation to use

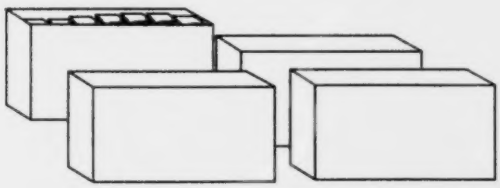
I. You have 23 folders. They are to be packed in boxes with 5 in each box. How many full boxes will you have? How many left over?

23 altogether
split up into separate boxes

Division:
Splitting up a whole amount into smaller groups all of the same size.

When you *know the total* amount and you are *cutting it up* use division. *Divide* to determine the number of groups or the number in each group

II. A shipment of books arrives. There are 4 cartons with 7 books in each carton. How many are there altogether?



7 in one box
how many are there altogether?

Multiplication:
Finding the total number of items in several equal groups

If you *know* the number in *one* box and you *want* to know how much you have in *many boxes* you should multiply.

PROBLEM SOLVING

I. Define the problem

- What are you trying to find out?

II. Plan the solution

- What data is needed?
- What operations should be used?
- Use estimation to approximate the answer.

III. Solve the problem

- Set up the calculations properly.
- Watch for copying errors.
- Check for calculator mistakes.

IV. Check to see if the answer is reasonable

- Does your answer fit with your initial estimate?
- Did you answer the question that was asked?

DIVIDING NUMBERS ENDING IN ZERO

There are several different ways to show division:

$150 \div 50$ $\qquad$ $\frac{150}{50}$ $\qquad$ $50\overline{)150}$

Division is often easier when using numbers that end in zero.

Try the following problems using a calculator:

1.) $\frac{4000}{20}$ $\qquad$ 2.) $\frac{5000}{50}$

3.) $\frac{400}{2}$ $\qquad$ 4.) $\frac{500}{5}$

Division Tip

1. Take an equal number of zeros off each number
2. Divide the numbers that remain

Now try these problems without using a calculator:

5.) $\frac{150}{50}$ $\qquad$ 6.) $\frac{5100}{10}$

7.) $\frac{300}{30}$ $\qquad$ 8.) $\frac{5100}{20}$

9.) $\frac{3150}{10}$ $\qquad$ 10.) $\frac{4160}{40}$

DIVIDING NUMBERS ENDING IN ZERO

Total Number of Items Needed	# Items per Carton	Whole Cartons	Extra Pieces
1,845	450		
4,793	210		
648	10		
1,084	190		
6,789	55		
16,861	150		
14,258	170		
120,000	45		

MULTIPLICATION/DIVISION

Try the following problems

1.) $4500 \div 10$

2.) 40×200

3.) $100\overline{)4500}$

4.) 30×6300

5.) $\frac{4000}{1000}$

6.) 95×21

7.) 50×54

8.) 72×25

9.) 90×700

10.) 5×462

MULTIPLICATION

Number of Tubes Per Box	Number of Boxes	Total Number of Individual Tubes
900	10	
152	100	
84	25	
276	50	
472	50	
1,000	25	
162	100	
98	10	
300	25	
500	100	
532	10	

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DIVISION

# Tubes Produced	# Tubes per Box	# Boxes
1,800	40	
4,760	20	
640	10	
1,084	100	
6,000	50	
16,860	100	
14,210	70	
120,000	40	

1. Enough tubes need to be filled to make a total of 4,000. If 50 can be done in one hour, how many total hours will be needed?

2. There are 360 boxes altogether. On a skid there are 5 cartons to a row stacked 4 rows high. How many skids are necessary?

3. A total of 50,000 individual tubes are needed. If they are packaged in 50's how many packs are needed?

MATH ON THE JOB

1. Given 6000 pieces with 60 in a box, how many boxes are there?

2. If there are 30 boxes of paints with 100 in a box, how many tubes of paint are there?

3. The warehouse had 120,000 pastels of which 60,000 were used. How many were left?

4. Given 387 red and 492 blue, what is the total number?

5. Twenty boxes were used to pack an order of 200 items. How many were packed in each box?

6. The least number of sticks of pastels produced in one week was 600 and the greatest was 1400. What is the difference between the highest and the lowest?

7. Evelyn needs legal pads to last eight weeks. Her department uses fifty pads per week. Legal pads come in packages of ten. How many packages does she need?

8. A total of 284 boxes are needed. Pastels come packed 25 to a box. How many individual pieces do you need?

9. A total of 398,000 pieces are needed. They come packed 100 to a box. How many boxes are needed?

10. You can fill 49 tubes per hour. How many hours will it take you to fill 900 tubes?

PRODUCTION

In a particular week the following numbers of pastels were produced.

Day	Number
Monday	370
Tuesday	400
Wednesday	390
Thursday	420
Friday	400

1. Are these numbers high or low? How do they compare with the production levels in your department?

2. Would production levels always stay the same? What are some of the factors that affect production levels?

3. You need 20,000 pastels. About how many weeks will that take?

   A. 2 weeks B. 5 weeks C. 10 weeks D. 20 weeks

4. About how much is the average daily production?

   A. 370 B. 380 C. 390 D. 400 E. 410

5. The yearly production is about:

   A. 10,000 B. 20,000 C. 50,000 D. 100,000 E. 200,000

6. About how many pastels are made per hour?

   A. 10 B. 30 C. 50 D. 100 E. 200 F. 400

MULTIPLICATION

Location	Number of Shrink Wrapped Packs	Number of Items in Each Pack	Total Number of Individual Items
RJ-51-B4	900	10	
WH-20-F	152	100	
WK-27-F	84	25	
WN-14-A	5000	50	
WO-28-F	472	50	
WM-49-C	1000	25	
WB-08-C	16,235	100	
WC-45-C	98,000	10	
WF-62-D	3000	25	
WI-45-E	500	100	
WI--46-D	532	10	

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DIVISION

Pick List Pick Quantity	*# Cartons Needed*		
	# Items per Carton	Whole Cartons	Extra Pieces
1845	450		
4793	210		
648	10		
1084	190		
6789	55		
16,861	150		
14,258	170		
120,000	45		

MATH ON THE JOB

Pick List Pick Quantity	*# Items per Carton*	
	Actual Amount of Stock	# Cartons Needed
1,800	40	
4,760	20	
640	10	
1,084	100	
6,000	50	
16,860	100	
14,210	70	
120,000	40	

For the problems below, circle your answer choice:

1. Enough pages need to be collated and stapled to make a total of 4,000 packages of materials. If 50 can be done in one hour, how many total hours will be needed?

   a) 8 hours b) 80 hours c) 800 hours

2. There are 360 bôxes altogether. On a skid there are 5 cartons to a row stacked 4 rows high. How many skids are necessary?

   a) 2 skids b) 20 skids c) 80 skids

3. A total of 50,000 individual pieces are needed. If they are shrink wrapped in 50's how many shrink wrapped packs are needed?

   a) 10 b) 100 c) 1,000

MATH ON THE JOB

1. You need to make 1976 pieces. You have just finished 80. How many remain to be completed?

_____

2. A pallet is being loaded by an operator with his stampings which weigh 5 pounds each. How many can the operator stack on the pallet if he has a weight limit of 600 pounds?

_____

3. Multiply: 50 X 700,000

_____

4. In the number 5812.57 what place is the 8 in?

   a. thousands b. hundreds c. tens d. ones

_____

5. A role of sheet metal runs through a press at 19 ft./min. If it runs for 5 min. how much material will be used? How much will be used in 3 hours and 15 minutes?

_____

6. Divide: 624 ÷ 6

_____

MATH ON THE JOB

7. An order requires 90,000 bottles. There are 510 per carton and 12 cartons per skid. Approximately how many skids are needed?

_____

8. There are 360 boxes altogether. On a skid there are 5 cartons to a row stacked 4 rows high. How many skids are necessary?

_____

9. A total of 50,000 individual pieces are needed. If they are packed in rows of 45 with 5 layers to a carton, how many cartons are needed?

_____

10. Find the number of bottles in 100 cartons.

Packing details:	Length:	6 rows	6 rows
Staggered rows:	Width:	9 bottles	8 bottles
	Height:	5 layers	

_____

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MATH ON THE JOB

11. Find the number of bottles in 100 cartons.

Packing details:	Length:	4 rows of 6
Alternating rows:	Width:	4 rows of 5
	Height:	4 layers

_____

12. Given 6000 pieces with 600 in a box, how many boxes are there?

_____

13. If there are 30 boxes of with 100 in a box, how many individual items are there?

_____

14. The warehouse had 120,000 items of which 60,000 were used. How many were left?

_____

15. Given 387 small and 492 large size, what is the total number? Estimate your answer first then give an exact answer.

_____

MATH ON THE JOB

16. Twenty boxes were used to pack 200 items. How many were packed in each box?

_____

17. There are 480 boxes altogether. On a skid there are 8 cartons to a row and they are stacked 5 high. How many skids are necessary?

_____

18. Evelyn needs legal pads to last fourteen weeks. Her department uses fifty pads per week. Legal pads come in packages of ten. How many packages does she need?

_____

19. A total of 2840 pieces are needed. They come packed 250 to a box. How many boxes do you need?

_____

20. A total of 763,000 pieces are needed. They come packed 100 to a box. How many boxes are needed?

_____

21. There are 12 cases with 525 per case. How many altogether?

_____

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MATH ON THE JOB ♦ SESSION 3

OBJECTIVES:

Upon completion of this session, students will be able to:

- round whole numbers and decimals
- use estimation

TOPICS:

- rounding
- estimation with whole numbers and decimals
- using estimation to find stock discrepancies

METHOD:

- guided discussion
- groupwork
- completion of worksheets

EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts: Rounding
  Estimation

ROUNDING

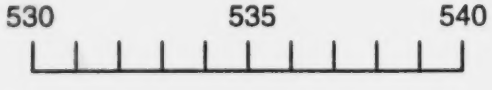
hundreds tens ones tenths hundredths thousandths

___ ___ ___ . ___ ___ ___

Round 38 to the nearest ten:

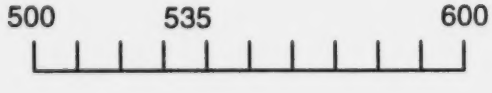
38 is closer to 40
round *up*

Round 535 to the nearest ten:



535 is halfway
round *up*

Round 535 to the nearest hundred:



535 is closer to 500
round *down*

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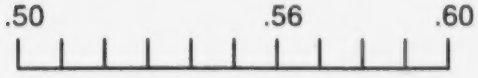
ROUNDING

hundreds tens ones tenths hundredths thousandths

___ ___ ___ . ___ ___ ___

Round .56 to the nearest tenth:



.56 is closer to .6
round *up*

To round a decimal fraction, determine the number of decimal places required,

- if the digit to the right of this decimal place is less that 5, eliminate all the digits following it.

  e.g. round 5.318 to the nearest tenth

  5.318 = 5.3

- if the digit to the right of this decimal place is 5 or more, add one to the last required digit and eliminate all the digits following it.

  e.g. round 5.318 to the nearest hundredth

  5.318 = 5.32

ESTIMATION

Estimation is used in many situations. Often, if a mistake has been made an estimate will help you catch it.

To estimate:

1. **Round off the numbers.**
2. **Do any arithmetic required with the rounded off numbers.**

See how quickly you can find any computer mistakes in the stock quantities listed below. Use estimation.

Total Quantity Received	# of Units	Quantity Per Unit
1,845	41	45
475	19	25
640	12	40
1,084	59	12
5,901	59	100
686	49	14
1,424	68	25
801	30	30

ESTIMATION

See how quickly you can determine the number of cartons needed. Use estimation.

Pick List	*Amount of Stock*	
Pick Quantity	**# Items per Carton**	**# Cartons Needed**
1,622	40	
582	19	
357	11	
9,295	100	
9,295	50	
6,861	25	
14,240	68	
95,471	30	
45,791	500	
652	45	

ESTIMATION

See how quickly you can determine about how many cartons are needed. Use estimation.

Total Quantity Needed	*Amount of Stock*		*# Cartons Needed*	
	# Items per Carton	# Items per Carton	Full Cartons	# Extra
1,622	40	Think about 40 (1,600 ÷ 40)		
582	19			
357	11			
9,295	100			
9,295	50			
6,861	25			
14,240	68			
95,471	30			
45,791	500			
652	45			

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ESTIMATION

See how quickly you can find any mistakes.

Pick List	*Amount of Stock*	
Pick Quantity	**# Items per Carton**	**# Cartons Needed**
1,622	45	37
582	19	31
357	11	30
9,295	100	90
9,295	25	372
6,861	250	25
14,240	68	210
95,471	30	3,000
45,791	500	75
652	45	15

MATH ON THE JOB ♦ SESSION 4

OBJECTIVES:

Upon completion of this session, students will be able to:

- add and subtract decimals
- multiply and divide decimals

TOPICS:

- arithmetic operations with decimals

METHOD:

- lecture
- discussion of worksheets
- groupwork

EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts: Working with Decimals

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CONVERTING FRACTIONS TO DECIMALS

Why are these coins called quarters?

How many are in one dollar?

One quarter is written $\frac{1}{4}$ or $.25

$\frac{1}{4}$ also means 1 out of 4

or $1 \div 4$

or $4\overline{)1.00}$

One half dollar is written $\frac{1}{2}$ or $.50

There are 10 dimes in a dollar therefore a **dime** would be written:

$\frac{1}{10}$ or $.10

There are 20 nickels in a dollar therefore a **nickel** would be written:

_____ or _____
fraction decimal

There are 100 pennies in a dollar therefore a **penny** would be written:

_____ or _____
fraction decimal

DECIMAL FRACTIONS

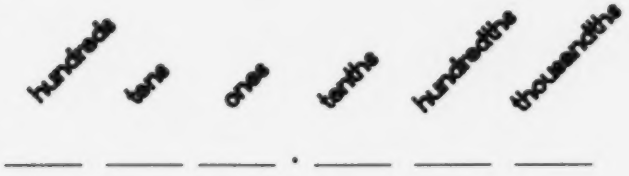
To read a decimal fraction, read the number as a whole number, then say the name of the place value where the last digit falls.

The following three numbers all have the same value:

0.5 is read as 5 tenths

0.50 is read as 50 hundredths

0.500 is read as 500 thousandths



The value of a number is determined by its place or location compared to the *decimal point*. A number has many different values depending on which place it is in.

Circle the largest number in each pair:

.1	.01
.6	.60
.6	.09

The decimal point is usually not written in whole numbers but it can be put in.

⇒ Where is the decimal point understood to be in the number 592?

⇒ What is half of .1?

⇒ What is twice as big as .8?

⇒ How much money would .8 represent?

COMMON/DECIMAL FRACTIONS

Express Common Fractions as Decimal Fractions

To express a common fraction as a decimal fraction requires division of the numerator by the denominator.

With repeating decimals, the division should be carried out one more place than the number of places required in the answer, then rounded.

Example: express $\frac{5}{7}$ as a 2 place decimal

$$\frac{5}{7} = 5 \div 7 = 7\overline{)5.000}^{\,.714} = .71$$

Express Decimal Fractions as Common Fractions

Read the place value of the last digit.

Example:

$$0.357 = \frac{357}{1000}$$

USING DECIMALS

There are shortcuts you can use when multiplying decimals by 10, 100 and 1000. To multiply a decimal by 10, move the decimal point **one place to the right.**

EXAMPLE: **5.879 X 10 = 58.79**

Now try multiplying by 100 and 1000. What happens to the decimal point?

5.879 X 100 = **5.879 X 1000 =**

Now try dividing. What happens to the decimal point?

35.465 ÷ 10 = **35.465 ÷ 100 =** **35.465 ÷ 1000 =**

1. 5.1 x 10 = _____
2. 3.27 ÷ 100 = _____
3. 5.8 ÷ 20 = _____
4. 4.5 x 100 = _____
5. 3.25 ÷ 10 = _____
6. 4.7 x 100 = _____
7. 3.875 x 100 = _____
8. 3.21 x 20 = _____

OPERATIONS WITH DECIMAL NUMBERS

A. Addition/Subtractions Skills

- **add/subtract decimals, mixed decimals, and whole numbers**
- **add/subtract decimal fractions**

Adding and Subtracting Decimal Fractions

To add/subtract decimal fractions:

1) arrange the numbers so that the decimal points are directly under each other,

2) add, as with whole numbers, and

3) place the decimal point in the answer directly under the other decimal points.

e.g. Add 5 + .02 Subtract 3.07 – .005

5.	3.070
+ .02	– .005
5.02	3.065

Note: To reduce the possibility of error, place zeros in all place values which have no digits.

OPERATIONS WITH DECIMAL NUMBERS

B. Multiplication and Division Skills
- multiply and divide decimals, mixed decimals, and whole numbers
- multiply and divide decimal fractions

Multiplying Decimal Numbers

To multiply decimals, multiply using the same procedure as with whole numbers. Place the decimal point in the answer the same number of decimal places as there are in both numbers being multiplied.

e.g.

	50.123	(3 places)
x	0.87	(2 places)
	43.60701	(5 places)

Dividing Decimal Numbers

To divide decimal fractions, (1) move the decimal point of the divisor as many places to the right as are necessary to make the divisor a whole number, (2) move the decimal point in the dividend the same number of places as were moved in the divisor, (3) place the decimal point in the quotient directly above the decimal point in the dividend, (4) add zeros to the dividend if necessary, and (5) divide as with whole numbers. Round as required.

e.g. Divide 0.643 by 0.28. Round to 3 decimal places

$$.28\overline{)0.6430} = 2.2964 \approx 2.296$$

DECIMAL FRACTIONS AND MIXED DECIMALS

1. Express each decimal in words.

   0.004 = _____

   0.021 = _____

   7.1 = _____

2. Express each of the following in decimal form.

   five and two hundredths = _____

   sixty-five thousandths = _____

   three and four ten-thousandths = _____

3. Express each common fraction as a decimal number.

   $\frac{3}{100}$ = _____ $\frac{11}{1000}$ = _____

   $5\frac{9}{10}$ = _____ $\frac{125}{1000}$ = _____

4. Express each decimal fraction as a common fraction.

   0.7 = _____ 0.11 = _____

   0.842 = _____ 14.613 = _____

DECIMAL FRACTIONS AND MIXED DECIMALS

5. Round each number in the left column to the place value indicated in each of the other columns.

	tenths	hundredths
5.732		
302.855		
12.0731		
5.897		
4.302		

6. Compare these decimals. Indicate which one is the smallest in each pair.

.001	.0010
.029	.03
.067	.076

7. Subtract the following:

159 – 72.4	4.7 – 3.12	140 – 16.412
_____	_____	_____

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DECIMAL FRACTIONS AND MIXED DECIMALS

8. Sheets of steel are stacked to a height of 4" on a pallet. The metal sheets are .025" thick. How many are on the pallet?

_____

9. A roll of sheet steel is 144 feet long and 3 feet wide. How many pieces 3 feet long and 2 feet wide can be produced from this roll?

_____

10. A roll of sheet metal stock contains 8240 lin. ft. of strip steel. It is shortened at a rate of 25.5 ft./min. on a production run which lasts 3 hours. How much stock remains on the roll?

_____

11. An automatic lathe produces parts at a rate of 30 per min. It ran for a total of 3.25 hours. How many bolts were produced?

_____

12. A company has an order for 536 sheet metal boxes. Each box uses 27 sq. ft. of 20 gauge. material. How many sq. ft. does it take to fill the order?

_____

13. A bar of steel 3" Ø (diameter) and 18 feet long weighs 180 lbs. How much would 36 bars weigh?

_____

DECIMAL FRACTIONS AND MIXED DECIMALS

14. A shop received 170 packages of sandpaper. Each package contained 25 sheets. If each sheet was cut into 4 parts, how many parts were made?

_____

15. A board is measured to be 6 inches in length. A piece measuring .95 inches is cut from it. How much is left?

_____

16. Multiply the following.

- 3.7 x 0.15 = _____
- 14.1 x 1.7 = _____

17. Divide the following: Round to the nearest hundredth.

- 36 ÷ 1.2 _____
- 75 ÷ 20.4 = _____

18. Determine the following:

- What is half of .001? _____
- What is half of .05? _____

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USING DECIMALS

1. A machine produces bottles at a rate of 30 per min. It ran for a total of 3.25 hours. How many bottles were produced?

   _____

2. A company has an order for 5360 bottles. Each layer contains 50 bottles. There are 10 layers to a skid. How many skids are needed?

   _____

3. A bottle 3" diameter and 8 inches high weighs 2.6 ounces. How much would 360 bottles weigh?

   _____

4. Multiply the following.

   - 6.4 X 0.15 _____
   - 7.2 X 1.7 _____

5. Divide the following (round to the nearest hundredth).

   - 36 ÷ 2.4 _____
   - 75 ÷ 10.2 _____

USING DECIMALS

6. Determine the following using a calculator. What operation should you use? Are the answers larger or small than the original number?

   - What is half of .001? _____
   - What is half of .05? _____

7. What is 6 divided by .5? Is the answer larger or smaller than 6?

   _____

   _____

MATH ON THE JOB • SESSION 5

OBJECTIVES:

Upon completion of this session, students will be able to:

- compute upper and lower limits
- determine if a measurement falls within a tolerance interval

TOPICS:

- tolerance
- radius and diameter

METHOD:

- lecture
- discussion

EVALUATION:

- self evaluation based on discussion

MATERIALS:

- handouts

TOLERANCES

- compute tolerances based on upper and lower limits of dimension

In industry, the tolerance of a part or component is the acceptable amount that the part or component may vary from a given size.

Definitions

Tolerance is the amount of variation permitted on the dimensions or surfaces of manufactured parts.

A basic dimension is the standard size from which the maximum and minimum limits are determined.

Limits are the extreme permissible dimensions of a part.

The tolerance interval is equal to the difference between the upper and lower limits.

If the tolerance of the length of a piece is 3.5″ ± .125″

then the length of the piece has:

- an upper limit of 3.625 inches.
- a lower limit of 3.375 inches

The tolerance interval is the difference between the upper and lower limit,

$$\begin{array}{r} 3.625 \\ -\ 3.375 \\ \hline .25 \end{array}$$

Tolerances can also be written as follows:

2.625″	upper limit
2.375″	lower limit

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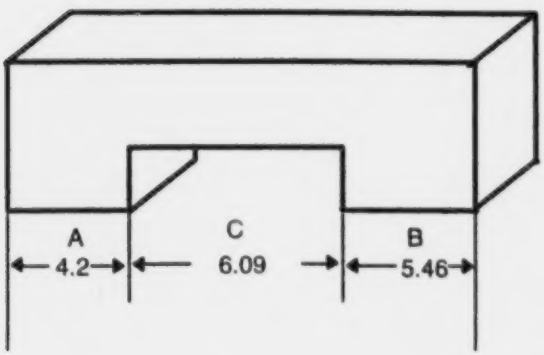
TOLERANCE

1. A piece is cut to the dimensions shown. Has it been cut to within the specifications?



Specifications on the blueprint:

A = 4.21 ± .02

B = 5.38 ± .02

C = 6.1 ± .02

2. A blueprint lists a dimension as follows: .275 ± 0.002

   Measurements are made of 6 different pieces as recorded below:

   ⇒ 0.2702

   ⇒ 0.278

   ⇒ 0.276

   ⇒ 0.27

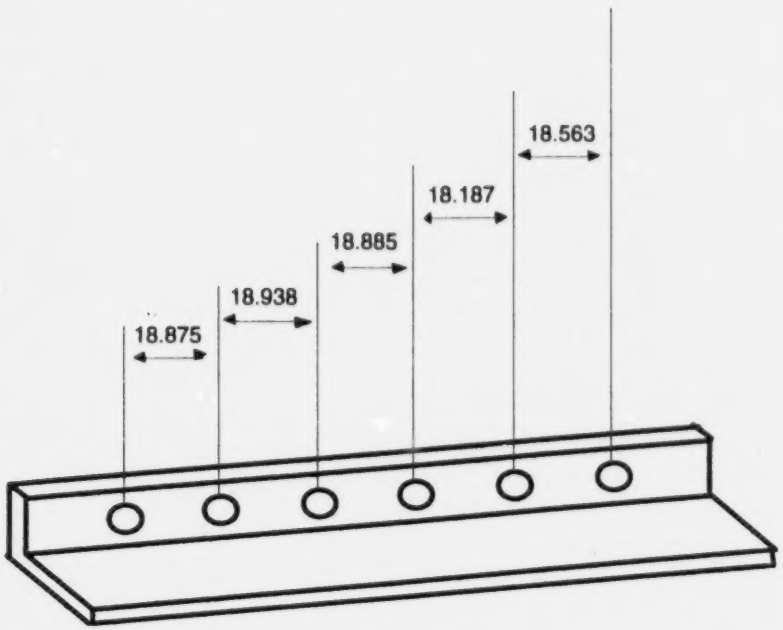
   ⇒ 0.274

   ⇒ 0.275

   Which ones are defective?

TOLERANCE

3. The drawing below gives the actual locations of six holes drilled in a length of angle iron.

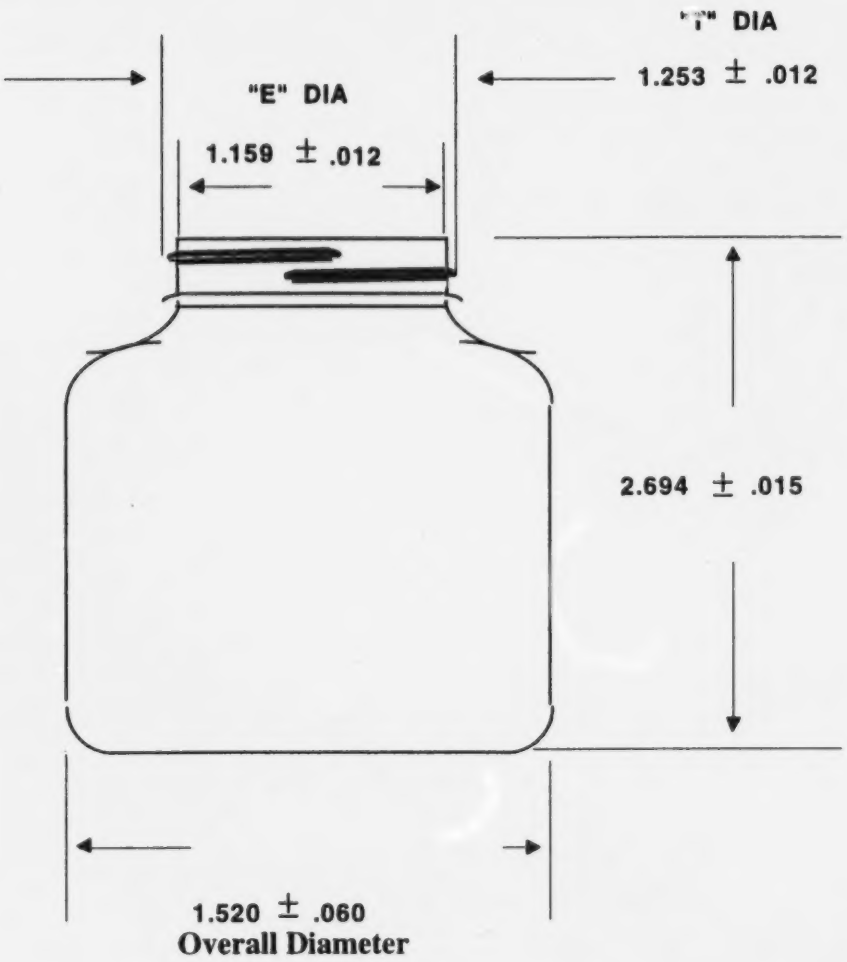


The blue print specifies that the distance from center to center of all the holes should be within the following tolerance interval:

18.8 ± .125 inches

Which holes are drilled incorrectly?

TOLERANCE



The following measurements were made on this bottle. Do the measurements fall within the tolerance intervals indicated above ?

Overall height: 2.7 inches

Overall diameter: 1.579 inches

"T" diameter: 1.242 inches

"E" diameter: 1.14 inches

TOLERANCE

1. A bottle is made to the following dimensions. Has it been made to within the specifications?

Actual Measurements:		Specifications on the blueprint. Find the upper and lower limit in each case:			
A =	4.2 inches	A =	4.21	±	.02
B =	5.46 inches	B =	5.38	±	.02
C =	6.09 inches	C =	6.1	±	.02

2. Bottles are to be manufactured to the following specifications: .275 ± 0.002

   An inspector records the following measurements.

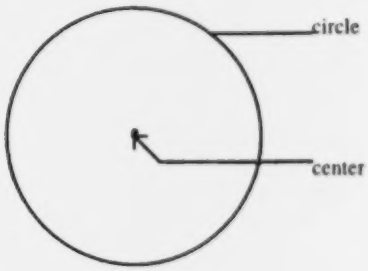
0.2702	0.278	0.276
0.27	0.274	0.275

   Which ones are defective?

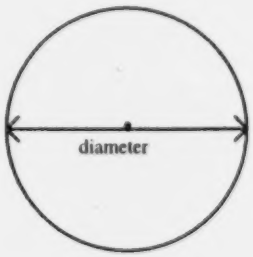
CIRCLES

- **Calculating diameter and radius**

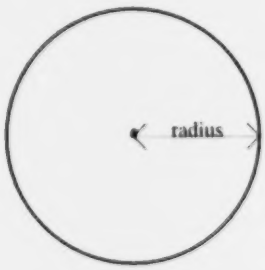
Circles are used repeatedly in drawings. A circle is a plane figure with each point on it an equal distance from a point inside, called the center of the circle.



The diameter of the circle is the distance across the circle through the center.



The radius is the distance from the center of the circle to a point on the circle.



The diameter of a circle is equal to twice the radius.
The radius of a circle is equal to one-half the diameter.

MATH ON THE JOB ♦ SESSION 6

OBJECTIVES:

Upon completion of this session, students will be able to:

- compute equivalent fractions
- convert from fractions to decimals

TOPICS:

- equivalent fractions

METHOD:

- lecture
- group discussion

EVALUATION:

- self evaluation

MATERIALS:

- handouts

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COMMON FRACTIONS AND MIXED NUMBERS

A. Basic Skills:
- express fractions in lowest terms and as equivalent fractions
- express mixed numbers as improper fractions
- express improper fractions as mixed numbers
- comparison of fractions

Definitions:

Fractions

- a value which represents part of a whole
- expressed as $\frac{\text{numerator (x)}}{\text{denominator (y)}} \Longrightarrow \frac{x}{y}$

e.g. $\frac{1}{2}$ $\frac{9}{16}$

Proper Fractions

- numerator is smaller than denominator

e.g. $\frac{3}{8}$ $\frac{15}{16}$

Improper Fractions

- numerator is larger than denominator

e.g. $\frac{11}{8}$ $\frac{13}{12}$

COMMON FRACTIONS AND MIXED NUMBERS

Mixed Numbers

- contains a whole number as well as a fraction

e.g. $1\frac{2}{3}$ $5\frac{1}{2}$

Lowest Terms

To express these fractions in lowest terms, "reduce" them by dividing both numerator and denominator by their greatest common factor.

Explanation:

$$\frac{6}{16}\frac{\div 2}{\div 2}=\frac{3}{8} \qquad \frac{8}{16}\frac{\div 8}{\div 8}=\frac{1}{2} \qquad \frac{12}{16}\frac{\div 4}{\div 4}=\frac{3}{4}$$

Equivalent Fractions

To express these fractions as equivalent fractions with a new denominator:

(1) divide the original denominator into the new denominator and
(2) multiply both the numerator and denominator of the original fraction by the value obtained.

(1) $\frac{8}{16} = \frac{\quad}{32}$ $(32 \div 16 = 2)$

(2) $\frac{8 \times 2}{16 \times 2} = \frac{16}{32}$

COMMON FRACTIONS AND MIXED NUMBERS

Mixed Numbers and Improper Fractions

e.g. Mixed Number => Improper Fraction

$$2\frac{1}{4} \Rightarrow 4 \times 2 + 1 \Rightarrow \frac{9}{4}$$

Improper Fraction => Mixed Number

$$\frac{7}{4} \Rightarrow 4\overline{)7}^{\,1} \Rightarrow 1\frac{3}{4}$$

Comparison of Fractions

To compare any two given fractions using < (less than), > (greater than), or = (equal to), change them to equivalent fractions with common denominators:

Example:

Which is bigger $\frac{3}{8}$ or $\frac{3}{16}$?

$$\frac{3}{8} = \frac{6}{16}$$

therefore

$$\frac{3}{8} > \frac{3}{16}$$

COMMON FRACTIONS AND MIXED NUMBERS

B. Addition/Subtraction Skills:

- determine least common denominator
- rewrite fractions as equivalent fractions using least common denominator
- add/subtract fractions and mixed numbers

To determine the LCD, find the smallest number into which all denominators divide into evenly.

e.g. The LCD for: $\frac{1}{8}$, $\frac{3}{4}$, $\frac{9}{16}$ is 16

because 8, 4, and 16 divide evenly into 16.

Adding Fractions/Mixed Numbers

To add fractions, express fractions as equivalent fractions with the LCD, add numerators, denominator remains the same. Reduce to lowest terms or express improper fractions as mixed numbers.

e.g. Add $\frac{1}{8} + \frac{3}{4}$

$$\frac{1}{8} = \frac{1}{8}$$
$$\frac{3}{4} = \frac{6}{8}$$
$$\frac{7}{8}$$

To add mixed numbers, add the whole numbers, add the fractions, combine whole numbers and fractions.

e.g.
$$4\frac{1}{2} = 4\frac{12}{24}$$
$$+ 2\frac{13}{24} = 2\frac{13}{24}$$
$$6\frac{25}{24} = 7\frac{1}{24}$$

COMMON FRACTIONS AND MIXED NUMBERS

Subtracting Fractions and Mixed Numbers

Follow addition rules, except:

If fractions cannot be subtracted, one whole unit must be borrowed and expressed as a fraction.

e.g. $9\frac{5}{8} = 9\frac{10}{16} \Rightarrow 8\frac{26}{16}$

$-\ 6\frac{15}{16} = -\ 6\frac{15}{16} \Rightarrow -\ 6\frac{15}{16}$

$2\frac{11}{16}$

COMMON FRACTIONS AND MIXED NUMBERS

C. Multiplication/Division Skills:
- multiply fractions and mixed numbers
- cancel common factors
- compute parts of a fractions
- divide fractions and mixed numbers

Multiplying fractions

To multiply fractions, multiply across numerators and across denominators. Reduce to lowest terms.

e.g. $\frac{2}{3} \times \frac{9}{16} = \frac{18}{48} = \frac{3}{8}$

To multiply mixed numbers, express mixed numbers as improper fractions and multiply as fractions.

e.g. $3\frac{1}{2} \times 1\frac{3}{21} = \frac{7}{2} \times \frac{24}{21} = \frac{4}{1} = 4$

Dividing Fractions

To divide fractions, change to multiplication problem by inverting the divisor, and multiply as fractions.

e.g. $\frac{5}{8} \div \frac{2}{3} =$

$\frac{5}{8} \times \frac{3}{2} =$

$\frac{15}{16}$

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COMMON FRACTIONS AND MIXED NUMBERS

1. Express fractions in lowest terms.

$\frac{32}{32} =$ $\frac{15}{1} =$ $\frac{6}{8} =$

$\frac{0}{8} =$ $\frac{14}{16} =$ $\frac{12}{16} =$ $\frac{14}{64} =$

2. Express as equivalent fractions.

$\frac{5}{16} = \frac{\quad}{32}$ $\frac{1}{8} = \frac{\quad}{16}$ $\frac{15}{4} = \frac{\quad}{64}$

$\frac{12}{32} = \frac{\quad}{8}$ $\frac{7}{1} = \frac{\quad}{16}$ $\frac{10}{8} = \frac{\quad}{32}$

3. Express mixed numbers as improper fractions.

$6\frac{3}{4} =$ $2\frac{1}{8} =$ $4\frac{1}{2} =$ $6\frac{7}{8} =$

4. Express improper fractions as mixed numbers.

$\frac{11}{4} =$ $\frac{67}{16} =$ $2\frac{70}{16} =$

5. Compare fractions using <. >, or =.

$\frac{13}{16} \quad \frac{3}{4}$ $\frac{15}{32} \quad \frac{30}{64}$

COMMON FRACTIONS AND MIXED NUMBERS

6. Determine the least common denominator for each set of fractions.

$\frac{1}{2}$ $\frac{1}{8}$ $\frac{1}{16}$ _____

$\frac{1}{4}$ $\frac{1}{16}$ $\frac{7}{8}$ _____

$\frac{3}{32}$ $\frac{1}{16}$ $\frac{5}{64}$ _____

7. Rewrite each of the above fractions as equivalent fractions using the least common denominator then add.

_____

_____

_____

8. Add the following fractions and mixed numbers.

$2\frac{1}{2} + 1\frac{3}{8} =$ _____ $\frac{1}{16} + \frac{3}{32} =$ _____

$3\frac{7}{8} + \frac{5}{16} =$ _____ $4\frac{3}{16} + \frac{1}{8} =$ _____

9. Subtract the following fractions and mixed numbers.

$\frac{5}{16} - \frac{3}{16} =$ _____ $\frac{7}{8} - \frac{3}{4} =$ _____

$\frac{9}{16} - \frac{13}{32} =$ _____ $8 - 5\frac{3}{4} =$ _____

CONVERSION TABLE

Fractions	Decimals
1/64	.0156
1/32	.0313
3/64	.0469
1/16	.0625
5/64	.0781
3/32	.0938
7/64	.1094
1/8	.1250
9/64	.1406
5/32	.1563
11/64	.1719
3/16	.1875
13/64	.2031
7/32	.2188
15/64	.2344
1/4	.2500
17/64	.2656
9/32	.2813
19/64	.2969
5/16	.3125
21/64	.3281

Fractions	Decimals
11/32	.3438
23/64	.3594
3/8	.3750
25/64	.3906
13/32	.4063
27/64	.4219
7/16	.4375
29/64	.4531
15/32	.4688
31/64	.4844
1/2	.5000
33/64	.5156
17/32	.5313
35/64	.5469
9/16	.5625
37/64	.5781
19/32	.5938
39/64	.6094
5/8	.6250
41/64	.6406
21/32	.6563
43/64	.6719

Fractions	Decimals
11/16	.6875
45/64	.7031
23/32	.7188
47/64	.7344
3/4	.7500
49/64	.7656
25/32	.7813
51/64	.7969
13/16	.8125
53/64	.8281
27/32	.8438
55/64	.8594
7/8	.8750
57/64	.8906
29/32	.9063
59/64	.9219
15/16	.9375
61/64	.9531
31/32	.9688
63/64	.9844
1	1.000

MATH ON THE JOB ♦ SESSION 7

OBJECTIVES:

Upon completion of this session, students will be able to:

- read a fractional inch scale

TOPICS:

- fractional inch scale

METHOD:

- discussion of worksheets
- groupwork

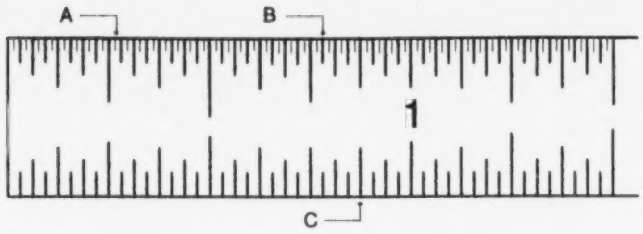
EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts
- 6" scale
- variety of screws

READING FRACTIONAL-INCH RULES



The top scale is sixty-fourths. (There are 64 divisions in 1 inch.)
The bottom scale is thirty-seconds. (There are 32 divisions in one inch.)

e.g. Read the following measurements on the enlarged fractional-inch rule shown:

length A: $\frac{17}{64}$ length B: $\frac{25}{32}$ length C: $\frac{7"}{8}$

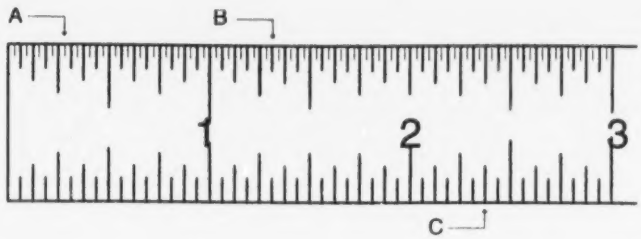
Often the edge of an object being measured does not fall exactly on a rule graduation. In these cases, read the measurement to the nearer rule graduation.

e.g. Read the following measurements, to the nearer graduation, on the enlarged fractional-inch rule shown:

length E: $1\frac{3"}{32}$ length F: $1\frac{3"}{8}$

READING FRACTIONAL INCHES

1. Determine the length of each measurement.

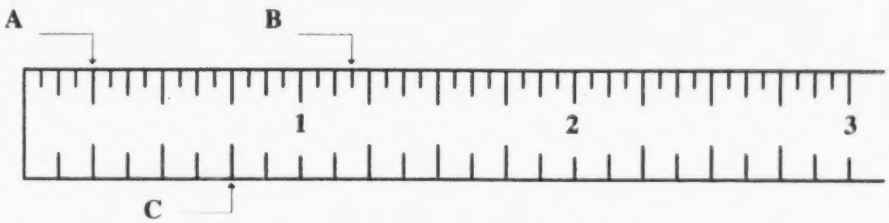


A. _____

B. _____

C. _____

2. Determine the length of each measurement.



A. _____

B. _____

C. _____

SCREW MEASUREMENT

The part number of each screw is a code that describes different characteristics of the screw.

- ◊ H3 are sheet metal screws
- ◊ H4 are machine screws

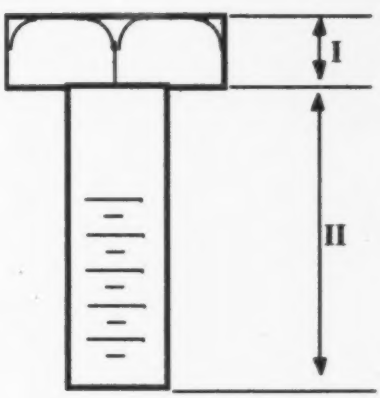
The following is a drawing of a machine screw with part number:

◊ H4 **06** 30 **204** C 0 B
I. II.

Make measurements I. and II. as labeled on the drawing and see if you can understand what the part number above means.

I. _____

II. _____



How many threads does this screw have?

_____

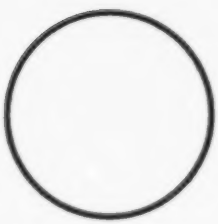
How many threads are there per inch?

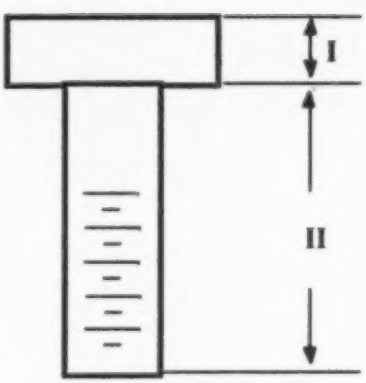
_____

SCREW MEASUREMENT

Find the screw that has the part number shown. Draw in any necessary details on the head. Make measurements I and II.

H4 **10** 24 **006** T 1 B

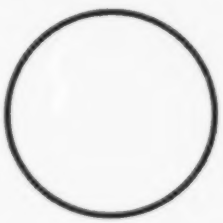


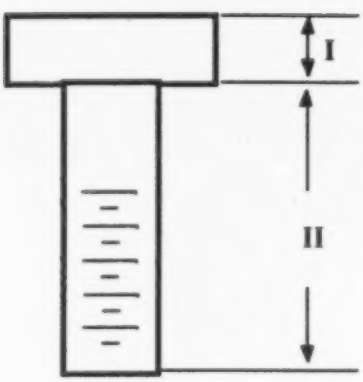


I. _____

II. _____

H3 **10 012** M B





I. _____

II. _____

WORKING WITH DRILL BITS

The most common power shop tool used in homes is the electric drill. Drill bits (the pointed, threaded tool that the drill spins) come in a variety of sizes. Most common are those whose diameters (width) are from $\frac{1}{16}$ inch to $\frac{1}{2}$ inch.

Drill bits are usually purchased in sets where each "next larger" bit is $\frac{1}{64}$ inch wider than the next smaller bit. Each bit size is given as a reduced fraction.

Here are some typical bit sizes – given in fractions of an inch. (Below, for comparison, are equivalent sizes given in 64ths of an inch.)

Bits	$\frac{1"}{16}$	$\frac{5"}{64}$	$\frac{3"}{32}$	$\frac{7"}{64}$	$\frac{1"}{8}$	$\frac{9"}{64}$	$\frac{5"}{32}$
64ths	$\frac{4"}{64}$	$\frac{5"}{64}$	$\frac{6"}{64}$	$\frac{7"}{64}$	$\frac{8"}{64}$	$\frac{9"}{64}$	$\frac{10"}{64}$

WORKING WITH DRILL BITS

■ Practice

In the following problems, change each fraction to a decimal.

1. To the nearest hundredth of an inch, what is the diameter of a $\frac{3"}{32}$ drill bit?

_____

2. Peter needs to drill a hole that will allow a 0.18 – inch-diameter wire to pass through. He wants the wire to fit as tightly as possible. Which of the three bits shown below should he use?

Bit #	Diameter
#1	$\frac{5"}{32}$
#2	$\frac{11"}{64}$
#3	$\frac{3"}{16}$

3. Circle each of the following bits that could be used to drill a drainage hole that is supposed to be "no wider than 0.35 inch."

$\frac{1"}{4}$ $\frac{5"}{16}$ $\frac{21"}{64}$ $\frac{11"}{32}$ $\frac{23"}{64}$ $\frac{3"}{8}$ $\frac{1"}{2}$

WORKING WITH DRILL BITS

1. Determine the following.

   What is $\frac{1}{2}$ of $\frac{3}{16}$? _____

   What is half of $\frac{7}{8}$? _____

   What number is twice as large as $\frac{1}{32}$? _____

2. The diameter of a circle is $4\frac{3''}{4}$. What is its radius?

   _____

   The radius of a circle is $\frac{3''}{8}$. What is its diameter?

   _____

3. A screw 6 inches long has 48 threads. How many threads per inch are there?

   _____

   A screw has a pitch of $\frac{1''}{16}$. How many threads per inch are there?

   _____

4. How much wire is needed to produce 38 pieces, each measuring $24\frac{3''}{8}$ in length?

   _____

WORKING WITH DRILL BITS

5. A room has a board for brass checks which has 48 hooks on a horizontal line. The first and last hooks are $1\frac{1"}{4}$ from the ends. The hooks in between are $1\frac{1"}{8}$ apart. What is the length of the board?

_____

MATH ON THE JOB ♦ SESSION 8

OBJECTIVES:

Upon completion of this session, students will be able to:

- convert measurements from feet to inches
- know the difference between linear feet and square feet

TOPICS:

- measurement conversions
- area

METHOD:

- discussion of worksheets
- groupwork

EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts

CONVERTING MEASUREMENTS

Now you have an idea of the size of some basic measurements. You will find many occasions to apply measurements to solving problems. To do so, you have to be able to *convert* from one size to another by multiplying or dividing. The following chart will help you make the conversions.

Standard U.S. Measurements

Time			Length			Weight & Capacity		
60 secs	=	1 mile	12 in	=	1 ft	16 oz	=	1 lb
60 mm	=	1 hr	36 in	=	1 yd	2,000 lb	=	1 T
24 hrs	=	1 day	3 ft	=	1 yd	8 fl oz	=	1 c
7 days	=	1 wk	5,280 ft	=	1 mi	2 c	=	1 pt
12 mos	=	1 yr	1,760 yd	=	1 mi	2 pt	=	1 qt
365 days	=	1 yr				4 qt	=	1 gal
366 days	=	1 leap yr						
10 yrs	=	1 decade						
100 yrs	=	1 century						

Looking at the chart, you see that a yard is a larger unit than a foot. To convert a larger unit of measure to a smaller unit, you multiply. This is because you want more of the smaller unit. To convert a smaller unit of measure to a larger unit, you divide. This is because you want fewer of the larger unit. Follow the steps below to decide whether to multiply or divide.

6 feet = ? yards

Is a foot a larger or smaller unit than a yard? ➡ smaller

Are you converting a smaller unit to a larger unit? ➡ yes

Do you multiply or divide? ➡ smaller

So, 6 feet ÷ 3 feet = 2 yards

Hint: First decide whether you are converting a larger unit to a smaller unit or a smaller unit to a larger one. It helps to write *sm* above the smaller unit and *lg* above the larger one.

CONVERTING MEASUREMENTS

Complete the following problems, showing your work in the space provided.

Compute

1. a. 3 tons = _____ pounds
   b. multiply or divide?

2. a. 3 minutes = _____ seconds
   b. multiply or divide?

3. a. 32 ounces = _____ pounds
   b. multiply or divide?

4. a. 60 inches = _____ feet
   b. multiply or divide?

5. a. 364 days = _____ weeks
   b. multiply or divide?

6. a. 8 decades = _____ years
   b. multiply or divide?

7. a. 48 hours = _____ days
   b. multiply or divide?

8. a. 3 cups = _____ fluid ounces
   b. multiply or divide?

9. a. 3 miles = _____ feet
   b. multiply or divide?

10. a. 24 months = _____ years
    b. multiply or divide?

87

MEASUREMENT CONVERSION

Inches	*Feet*
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	

To convert inches to feet ***Divide by 12***
feet to inches ***Multiply by 12***

MEASUREMENTS

1. A worker has a sheet of metal 81 inches long. He needs to cut two pieces of metal each 39 inches long. How long is the sheet of metal that is left over?

_____

2. One sheet of metal is .5 inches thick. How thick is a stack of sheet metal with 13 sheets?

_____

3. A worker has two pieces of sheet metal. One is 5′ 6″ long. The other is 8′ 9″ in length. How much sheet metal is there altogether?

_____

4. From a piece of sheet metal 2′ 8″ long a worker cut 1′ 9″. How long was the sheet of metal that was left over?

_____

5. A sheet metal worker orders 30 square feet of sheet metal. Draw a picture of this piece of metal using graph paper. How many linear feet is your piece of metal? What is the difference between square feet and linear feet?

_____

_____

MEASUREMENTS

6. Name five situations at home or on the job where you would need to measure something using linear feet or inches. Name five situations in which you would need to use square feet or square inches.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

DEGREE OF PRECISION

- Determine the degree of precision of commonly used measuring instruments

The degree of precision specified for a particular machining operation dictates the type of machine, the machine setup, and the measuring instrument used for that operation. Since the exact length of an object cannot be measured, by increasing the number of graduations on a measuring instrument, the degree of precision is increased.

The precision of measurement depends on the measuring instrument used. The degree of precision of a measuring instrument depends on the smallest graduated unit of the instrument.

Limitations of Measuring Instruments

Following are the limitations on the degree of precision possible of some measuring instruments:

Steel rule (decimal inch)
0.01" or .02" (depending on the smallest gradation)

Micrometers: 0.001" (decimal inch)

Dial calipers: 0.001" (decimal inch)

Degree of Precision of Numbers

The degree of precision of a number depends upon the unit of measurement. The degree of precision of a number increases as the number of decimal places increases.

e.g. degree of precision of:	to the nearest:
2"	inch
2.0"	tenth of an inch
2.00"	hundredth of an inch
2.000"	thousandth of an inch

MATH ON THE JOB ♦ SESSION 9

OBJECTIVES:

Upon completion of this session, students will be able to:

- convert within the metric system
- convert between English and metric measurements

TOPICS:

- Metric System
- English System

METHOD:

- lecture
- discussion of worksheets

EVALUATION:

- self evaluation

MATERIALS:

- handouts

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METRICS

Fractions are the basis of the English measuring system.

Decimals are the basis of the metric measuring system.

- **Liters** are used to measure **liquid volume**
- **Grams** are used to measure **weight**
- **Meters** are used to measure **distance**

The same prefixes are used with each root word:

Kilo	Hecto	Deka	**Unit**	Deci	Centi	**Milli**
			Liter			
			Gram			
			Meter			

Measurements get 10 times larger each place you go to the left.
■ *or*
10 times smaller each place that you move to the right.

1. Is a kilogram (kg.) larger or smaller than a gram(g)? By how much?

2. Is a milligram (mg.) larger or smaller than a gram(g)? By how much?

3. You can convert from one unit to the other by simply moving the decimal point one place left or right for the number of places you move left or right on the chart.

METRICS

4. For instance 5 g. would be _____ kg. (move the decimal point 3 places to the left)

5. Try the following:

   81 g. = _____kg. 671 g = _____kg.

   .345 kg = _____g. .475 kg. = _____g.

   1104.320 kg. = _____whole kg? and = _____grams left over?

6. In the metric system weight is measured in grams. If one ounce equals grams, which is larger, an ounce or a gram?

7. How does a kilogram compare to a pound?

8. See if you can decide whether kg. or g. would be used to weigh each object. About how much would each weigh in the metric system?

   - a paper clip
   - a person
   - a book

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METRICS

9. Find the total weight of the ingredients listed below:

Part No.	UM	Qty Req'd
MG-6642	KG	6.54
W10007	GR	327.16
W10027	KG	.33

10. In 8.21 kg. how many whole kilograms are there? How many grams left over?

11. Convert 22 pounds to kilograms.

12. What metric units would you use to measure the weight of a tube of paint?

CONVERSION FACTORS

	Multiply → *number of*	→	*To get* *number of* ↓
Length	Millimeters	0.04	Inches
	Meters	3.28	Feet
	Meters	1.09	Yards
	Kilometers	.62	Miles
Weight	Kilograms	35.71	Ounces
	Grams	0.035	Ounces
	Kilograms	2.20	Pounds
Liquid Volume	Milliliters = cc	0.034	Fluid ounces
	Liters	2.11	Pints
	Liters	1.06	Quarts
	Kiloliters	0.26	Gallons
↑	*To get* *number of* ←	←	*Divide* *number of* ←

CONVERSION FACTORS

	Multiply →	→	↓
Length	Millimeters	0.039	Inches
	Centimeter	0.393	Inches
	Meters	3.275	Feet
	Meters	1.094	Yards
	Kilometers	.621	Miles
Weight	Kilograms	35.248	Ounces
	Grams	0.035	Ounces
	Kilograms	2.203	Pounds
Liquid Volume	Milliliters = cc	0.0338	Fluid ounces
	Liters	2.113	Pints
	Liters	1.057	Quarts
	Liters	0.264	Gallons
↑	←	←	*Divide*

UNITS OF MEASURE (ENGLISH)

- express an English unit of measure in larger or small units of measure

The ability to measure with tools and instruments and to compute measurements is a basic requirement in the machine trades. Presently, the United States uses the English system of measure. Although this system includes all types of measure (length, area, volume, capacity), the machine trades use length measure most often.

English Units of Linear Measurement

- 1 yard (yd.) = 3 feet (ft.)
- 1 yard (yd.) = 36 inches (in.)
- 1 foot (ft.) = 12 inches (in.)

Expressing English Units of Measure as Smaller/Larger Units

To express a larger unit of length as a smaller unit of length, multiply the given length by the number of smaller units contained in one of the larger units.

e.g. express 2 feet as inches

since there are 12 inches in 1 foot,

multiply 2 by 12

2 x 12 = 24

so 2 ft = 24 in

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UNITS OF MEASURE (ENGLISH)

To express a smaller unit of length as a larger unit of length, divide the given length by the number of smaller units contained in one of the larger units.

e.g. express 67 inches as feet

since there are 12 inches in 1 foot,

divide 67 by 12

$$12\overline{)\,67}\quad \begin{matrix}5\\ \text{remainder } 7\end{matrix}$$

so 67 inches = 5 feet 7 inches

$\Leftrightarrow$ *OR*

$\therefore$

$67 \div 12 = 5.583$

so 67 in. = 5.583 ft.

MATH ON THE JOB ♦ SESSION 10

OBJECTIVES:

Upon completion of this session, students will be able to:

- read charts and graphs
- calculate a per cent of a number
- convert fractions to decimals to per cents

TOPICS:

- charts
- graphs
- per cents

METHOD:

- lecture
- discussion of worksheet
- group discussion

EVALUATION:

- self evaluation based on discussion of the worksheets

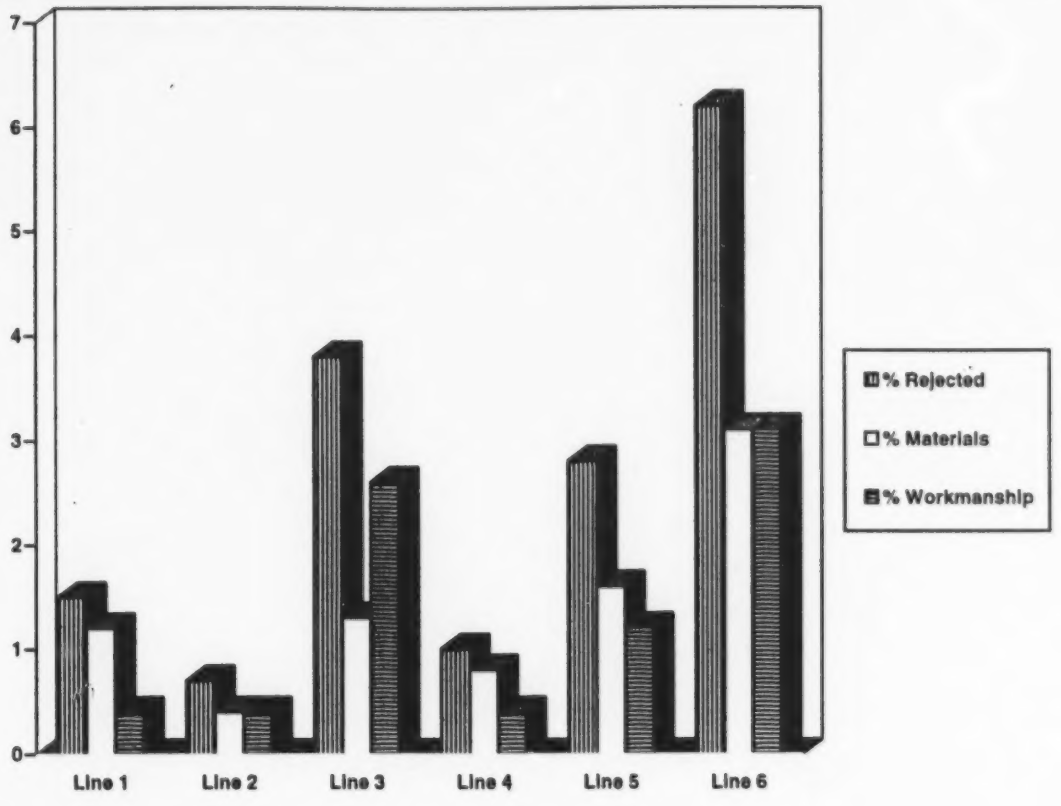
MATERIALS:

- graph paper
- handouts

PER CENTS

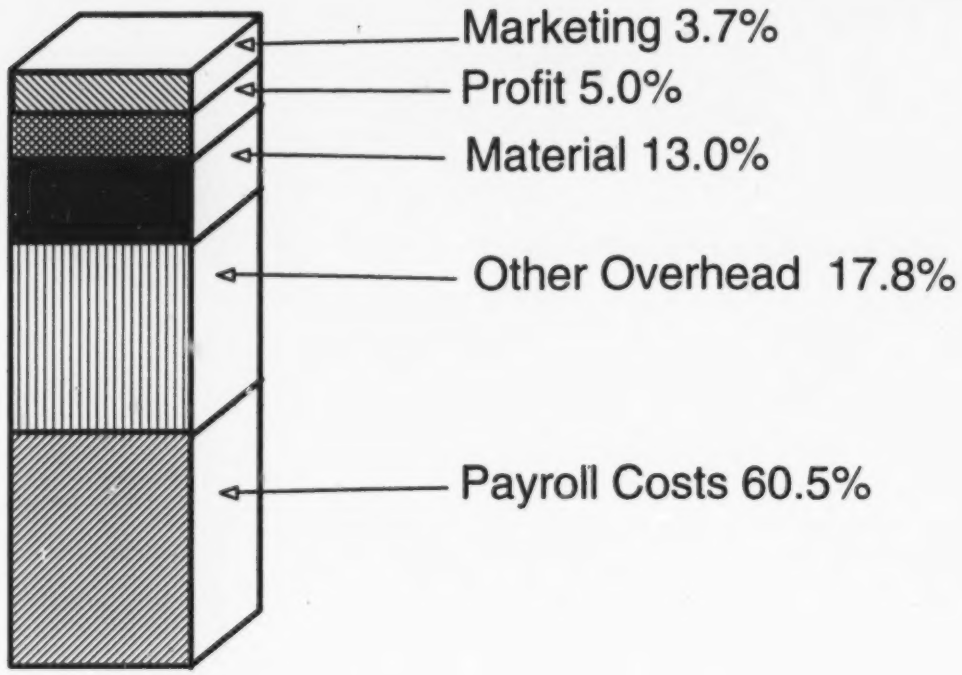
FINAL INSPECTION BY LINE

% REJECTED



% Rejected	1.5	0.7	3.8	1	2.8	6.2
% Materials	1.2	0.4	1.3	0.8	1.6	3.1
% Workmanship	0.4	0.4	2.6	0.4	1.2	3.1

PER CENTS



1. What does the above diagram show you?

2. The artist who drew the picture made a mistake. Can you tell him what's wrong?

3. Use graph paper to draw the picture correctly.

PER CENTS

4. What do all the percentages add up to?

5. What does the word *overhead* mean? List some things that might be included in overhead.

6. **Per cent** means per hundred.

⇒ Your company makes 5% profit.

⇒ 5% means $5.00 out of every $100.

⇒ or _____ out of every $1

⇒ To get this answer you had to DIVIDE by _____

⇒ There is a shortcut way to do this division. What is the shortcut?

⇒ If your company takes in $500,000 how much would be profit?

PER CENTS

7. Out of that same $500,000 how much would go to cover:

⇒ marketing?

⇒ material?

⇒ overhead?

⇒ payroll?

MONTHLY AVERAGES IN PERCENT OF LOST PRODUCTION DUE TO ERRORS

Refer to the accompanying graph and chart to answer the following questions:

1. What patterns do you see in this data? Are there differences by season? by year? Which helps you to see patterns more clearly, the chart or the graph?

2. What is the difference in average percent between 1988, 1990 and 1992 for the month of January? Which is easier to use, the chart or the graph?

3. What is the average percent for the entire year of 1988? 1990? 1992?

4. Show your data for the year on another bar graph. Use the same data to make a line graph.

MONTHLY AVERAGES IN PERCENT OF LOST PRODUCTION DUE TO ERRORS

5. Could the original data have been represented on a line graph?

6. Sometimes averages are used to predict what will happen in the future. Find an average for each month (for all the years combined). Use these averages as a projection for what might occur in 1993.

7. Compare your projection with the actual data for 1993. In what ways did the actual data different from your projections?

8. What other possible reasons are there for lost production time besides errors? Estimate the approximate per cent of time lost to each cause. Represent it on a pie chart.

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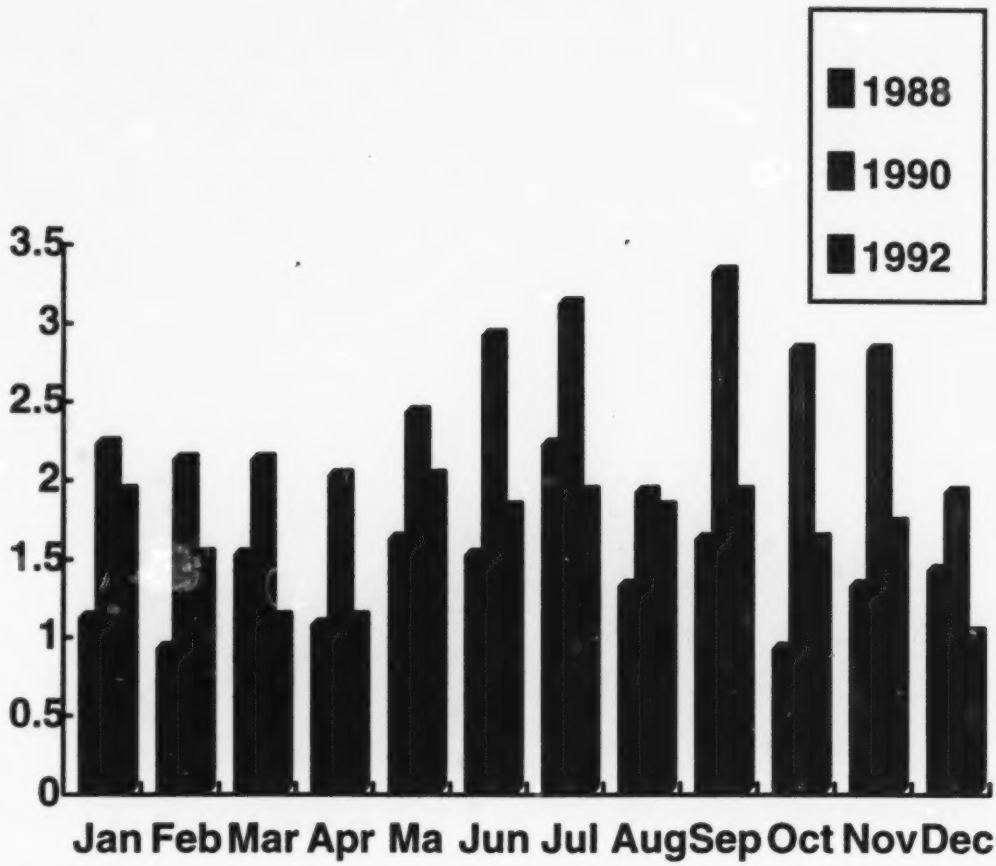
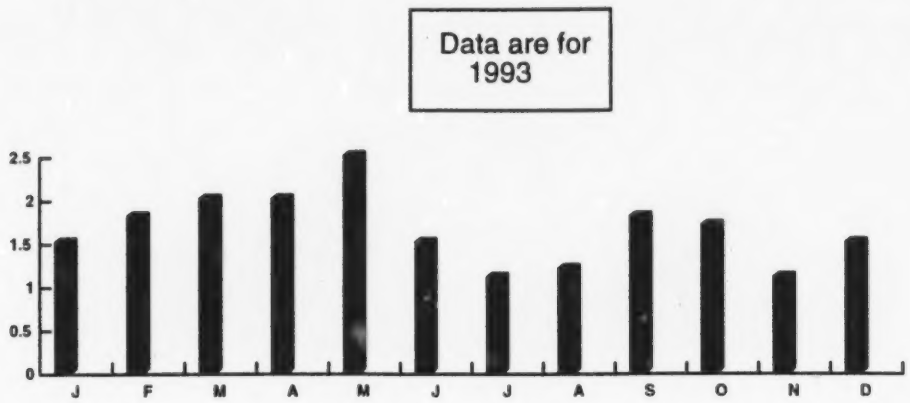
MONTHLY AVERAGES IN PERCENT OF LOST PRODUCTION DUE TO ERRORS

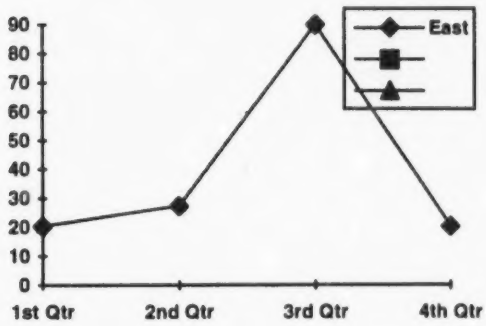


	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1988	1.1	0.9	1.5	1.05	1.6	1.5	2.2	1.3	1.6	0.9	1.3	1.4
1990	2.2	2.1	2.1	2.0	2.4	2.9	3.1	1.9	3.3	2.7	2.7	1.9
1992	1.9	1.5	1.1	1.1	2.0	1.8	1.9	1.8	1.9	1.6	1.7	1.0

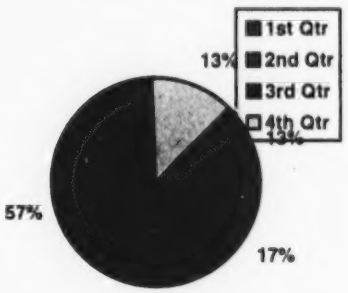
MONTHLY AVERAGES IN PERCENT OF LOST PRODUCTION DUE TO BREAKDOWNS



Example of a line graph



Example of a pie chart



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MATH ON THE JOB ♦ SESSION II

OBJECTIVES:

Upon completion of this session, students will be able to:

- read a pay check
- calculate medical benefits
- calculate decimal time
- fill out a time card

TOPICS:

- reading a pay check
- reading a medical benefits booklet
- filling out a time card

METHOD:

- discussion
- completion of worksheets

EVALUATION:

- self evaluation based on discussion of the worksheets

MATERIALS:

- handouts

PAYCHECK

Description	Hours	Amount	Description	Amount	YTD Amount	**Empl. No.** 20331
Regular	40.00	8.90	Unemp-Tax	15.30	76.50	**Soc. Sec. # 124-55-3385**
			Medical	14.53	72.65	
			401K Invst.	9.48	47.40	**Week Ending 2/4/94**
Gross Wage		356.00			1,780.00	**Check Date 2/9/94**
						Check No. 7364

CURRENT INFORMATION

Gross Pay	Fed. W/H Tax	F.I.C.A.	State Tax	City/County Tax	Total Other Deduct.	NET PAY
356.00	89.75	31.78	14.93	N/A	39.91	179.63
1,780.00	448.75	158.90	74.65	N/A	196.55	901.15

YEAR TO DATE

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PAYCHECK

Description	Hours	Amount	Description	Amount	YTD Amount	Empl. No.
Regular Gross Wage			Unemp-Tax Medical 401K Invst.			Soc. Sec. # Week Ending Check Date Check No.

CURRENT INFORMATION

Gross Pay	Fed. W/H Tax	F.I.C.A.	State Tax	City/County Tax	Total Other Deduct.	NET PAY

YEAR TO DATE

PAYCHECK

This is a **sample paycheck stub** but as you can see, not all of the information is on the check. Look at the information provided about this employee and write it in the paycheck stub in the correct places.

$ This paycheck belongs to **Karen Hopkins.** Karen's social security number is 223-57-8694. Her employee number is 20344.

$ This year, Karen worked her regular 40 hours per week. Her gross wage is 8.75 per hour. This check is from week 16. She gets paid biweekly.

$ So far this year, Karen's gross income is $5600.

$ The company takes out for unemployment tax. Every week they take out $11.24.

$ The pay period ends 4/23/93. The check will be dated for a week later.

$ For Medical insurance, the company takes out $42.30 from each paycheck.

$ Karen has a 401K Investment through the company, also. So far this year Karen has set aside $698.56 into that investment.

$ The Federal Government withholds $115.78 from every one of Karen's paychecks.

PAYCHECK

$ Karen has money taken out for Social Security. They take out $20.34 per week.

$ The State also takes out taxes from Karen's check. Every week they take out $12.01.

$ $ BONUS questions of the day!!! $ $

$ What was the *total* of her **deductions**?

_____

$ What was Karen's **NET PAY** for this paycheck?

_____

$ This is week 16 of the year. Fill in Karen's paycheck

_____

$ What per cent of her salary is taken out by the federal government for income taxes? for social security?

_____

_____

PAYCHECK

$ What percent does the state take out for taxes?

_____

$ What percent of her salary is taken out all together?

_____

$ Last year Karen was in the same tax bracket. The federal government took out $2700 in income taxes. How much was her gross salary last year? What percent raise did she receive?

_____

_____

$ Assuming that she gets the same percentage raise each year, figure out her salary the year before.

_____

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MEDICAL BENEFITS

Effective 07/01/93

		Monthly	Weekly
	RCHP		
	Employee only	$40.00	$9.23
	For you and one dependent	55.00	12.69
	For you and more than one dependent	90.00	20.77
	US Healthcare		
NJ	Employee only	$45.00	$10.38
	For you and one dependent	50.00	11.54
	For you and more than one dependent	100.00	23.07
PA	Employee only	$35.00	$8.08
	For you and one dependent	45.00	10.38
	For you and more than one dependent	80.00	18.46
	ETENA		
Managed Choice	Employee only	$15.00	$3.46
	For you and one dependent	30.00	6.92
	For you and more than one dependent	55.00	12.96
Open Choice	Employee only	$20.00	$4.62
	For you and one dependent	40.00	9.23
	For you and more than one dependent	70.00	16.15
Comprehensive Plan	Employee only	$20.00	$4.62
	For you and one dependent	35.00	8.08
	For you and more than one dependent	55.00	12.69

MEMO

To: All employees

From: Personnel

Subject: Medical Insurance

Over the last several months we have been researching alternative medical plans and we are pleased to announce that we will be offering a new plan beginning January 1, 1994.

The plan will allow you to decide at the point of service whether you would like to seek care with a preferred provider, and receive a higher level of benefits, or choose a non-preferred provider and receive a lower level of benefits.

Employee contributions to the new plan will be as follows:

Single	$28.50 per month	Family	$82.94 per month
Parent/Children	$51.17 per month	Husband/Wife	$60.28 per month

We are anticipating that all rates will increase 10% within the next year. At that time all employees will be notified of the appropriate changes.

MEDICAL BENEFITS

Study the memo on medical insurance and see if you can answer the following questions about it:

1A. If you are a single parent with a child what will you pay per month?

1B. If you receive a paycheck on the 15th and 30th of each month how much would be taken out of each paycheck for each option?

1C. How much would be taken out each year?

2A. Last year you had 2 visits to the emergency room ($300 each).You had 20 doctor visits after that ($100 each) and one visit to a specialist ($250). If you are single how much would you have paid for medical care if you stayed within the network?

2B. For the same visits as above what would you have paid if you went outside the network?

3. If you are single, how much extra money would you have to spend after the rates go up?

4. If you buy family coverage, how much extra money would you have to spend after the rates go up?

SUMMARY OF PROPOSED MEDICAL BENEFITS

Plan features	Preferred Benefits	Non-Preferred Benefits
Deductible	None	$250 Individual $750 Family every contract year
Office Visits	$5 copay	70%
Routine Physical	$5 copay	Not covered
Routine Eye or Hearing Exam	$5 copay	Not covered
Routine Mammography	$5 copay	Not covered
Specialist	$5 copay	70%
Hospital Inpatient	$100 copay per confinement	70% after $250 deductible per confinement and contract year deductible
Emergency Room	$25 copay	$25 deductible
Hospital Surgery	100%	70%
Skilled Nursing Facility	100%	70%
Home Health Care	100%	70% up to 120 visits per contract year

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MEMO

To: All employees

From: Personnel

Subject: Medical Insurance

We are pleased to announce that you will have a choice of 3 levels of HMO coverage.

You must decide which option you wish to choose. Study the enclosed rate sheets to make your decision.

Employee contributions to the new plan vary depending on which level you choose: Value HMO, Patriot X HMO or Premium HMO.

We are anticipating that all rates will increase 10% within the next year. At that time all employees will be notified of the appropriate changes.

MEDICAL BENEFITS

Study the memo on medical insurance and see if you can answer the following questions about it:

1A If you receive a paycheck every other week how much would be taken out of each paycheck for each option if you are a single parent with a child?

1B. How much would be taken out each year?

2. Last year you had 2 visits to the emergency room ($300 each). You had 20 doctor visits after that ($100 each) and one visit to a specialist ($250). If you are single with a child how much would you have paid for medical care for each option?

3. If you are single with a child, how much extra money would you have to spend after the rates go up?

4. If you buy family coverage, how much extra money would you have to spend after the rates go up?

JOB LABOR CARD

EMP # _____ **EMP. NAME** _____

DATE _____ **DEPT.** _____

JOB NUMBER	CLIENT	ACTIVITY CODE	TOTAL HOURS	TIME	
				START	STOP

TOTAL HOURS _____

JOB LABOR CARD

Jim Lewis (empl. # 45582) works in the warehouse. On a typical day he comes to work at 8:00, takes a fifteen minute morning break and leaves for lunch at 11:45. He returns from lunch at 12:15, takes a fifteen minute afternoon break and finishes work at 4:00 P.M.

Today, March 8th, he had a busy day. Use the activity codes and information given below to fill out his job labor card.

Today, he goes to get his work order first thing in the morning. He takes 5 minutes to read his work order and sees that he will be packaging and shipping materials for a large customer.

After taking 15 minutes to set up his work area, he works until 9:25 assembling 60 boxes. While the picker is filling the boxes, Jim takes until 10:10 to assemble envelope inserts. He then takes his break.

When he returns from his break, he spends until 11:05 shrink-wrapping the envelope inserts. It takes him until lunch to put the envelopes into the boxes.

After lunch, Jim is ready to run off his labels. He finishes at 12:50. He takes until 2:25 addressing and sealing the boxes.

Jim now has to weigh the shipment. After 10 minutes weighing, he decides that the shipment is too large and too heavy to send via the post office. So, he has to complete the paperwork to send the boxes via UPS. This takes him until 3:05. He tags the shipment with box numbers and destination codes and does a 10 minute clean-up. He realizes that it is now time to go home and he never got his afternoon break.

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ACTIVITY CODES

500	Assembly
505	Breakdown
510	Clean Up
515	Copies
520	Metering/Sealing
525	Overs
530	Packing
535	Picking
545	Problem
550	Problem – Client
555	Punching
560	Rework – Client
565	Rework
570	Set Up
575	Shipping – Federal Express
580	Shipping – Freight
585	Shipping – General
590	Shipping – Postage
595	Shipping – Prep.
600	Shipping – UPS
605	Shrink Wrapping
610	Sort, Tie, Sack
650	Client Receipt
655	Cycle Counts
660	Hi Lo Operation
665	Inventory
670	Maintenance
675	Messenger
680	Physical Counts
685	Returns
690	Rewarehousing
695	Scrap
700	Stock

WEEKLY TIME SHEET

You worked the following hours last week:

	Begin	End
Monday	8:00 A.M.	3:30 P.M.
Tuesday	8:00 A.M.	5:30 P.M.
Wednesday	8:00 A.M.	4:00 P.M.
Thursday	8:30 A.M.	4:00 P.M.
Friday	9:30 A.M.	5:30 P.M.
Saturday	7:30 A.M.	3:00 P.M.

1. Change all the times to military time.

2. Calculate the number of hours worked. Use decimal time.

3. Calculate the overtime worked on weekdays

4. Calculate the overtime worked on Saturday

5. Calculate your weekly paycheck assuming that you made $10 per hour.

MATH ON THE JOB ♦ SESSION 12

OBJECTIVES:

Upon completion of this session, students will be able to:

- use ratios and proportions

TOPICS:

- ratios
- proportions
- piece work
- job estimates

METHOD:

- class discussion

EVALUATION:

- self evaluation based on discussion of the worksheets

RATIO AND PROPORTION

Comparing Numbers

We all need to compare numbers. when you go to the store you compare prices. When you but a car loan you compare options from several dealers. On the job, you must be able to compare costs and production rates.

Ratios

There are two basic ways to compare numbers. You can subtract one number from another or you can divide them. Finding the difference (subtraction) tells you how much more expensive one product is than another.

Comparing using division is also very helpful. For instance, suppose your boss tells you to increase the production on a particular machine in your plant by 40 units a day. To understand what this means you must first know what the machine normally produces. If the machine normally produces 40 units, he is asking you to double your production from 40 up to 80 units per day. If, however, the machine normally produces 10,000 units per day then an increase from 10,000 up to 10,040 units is not a particularly large increase.

When you compare one value to another by dividing the result is called a ratio.

Ratios can be expressed in several different ways:

$40 : 80$ or $40 \text{ to } 80$ or $\frac{40}{80}$

A ratio of $\frac{40}{80}$ or $40 \text{ to } 80$ is the same as $\frac{1}{2}$ or $1 \text{ to } 2$

RATIO AND PROPORTION

- The ratio of 1.8 to 2 is equal to which of the following:

  9 to 1 9 to 10 9 to 20 18 to 100 18 to 20

- A supervisor conducts a time study and determines that it takes him 7 minutes to complete 15 items. How many items should he expect to be completed in an hour?

  _____

- Two workers working on the same job, worked at different rates. The first worker was able to complete in .5 hour the same amount of materials that it took the second worker .75 of an hour to complete. The supervisor said that it would take the second worker 4 hours to complete what the first person could do in 3 hours. Was he correct?

  _____

PIECEWORK

Your supervisor tells you that piecework is available for you to take home. In order to determine the pay rate he conducts a trial run and determines that in 5 minutes he can complete 12 items. He wishes to offer the piecework at a rate of $7.50 per hour. How much should be paid per item?

_____

You take home 250 of the items. It takes you an hour and three-quarters to complete the work. How much did you actually earn per hour?

_____

DIRECT MAIL ESTIMATE

JOB: Brochure into 9 X 12 envelope.
Mail 1st class.
500 envelopes to be inserted.

Step

Unit Cost	**Cost**	**Time**
Unload Stock From Truck Move Stock Into Warehouse $9/hour	_____	30 min.
Transfer Stock From Warehouse Into Assembly $9/hour	_____	20 min.
Set Up Brochures and Envelopes Onto Work Tables $9/hour	_____	20 min.
Pick Up Brochures and Insert Into Envelopes $15/hour	_____	250/hour
Label Envelopes $15/hour	_____	300/hour
Seal and Meter Envelopes $15/hour	_____	500/hour
Transport Envelopes to Post Office $9/hour	_____	30 min.
TOTALS	_____	

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DIRECT MAIL ESTIMATE

1. If it takes 30 minutes to unload 500 brochures how many would be unloaded in 1 minute? in 5 minutes? in 10 minutes? in 1 hour?

2. If the envelopes can be labeled at the rate of 300 per hour how many would be labeled in 1 minute? in 5 minutes? in 10 minutes? in 30 min.?

3. Why is this called an *estimate*?

4. Find the total time for this job.

5. Find the cost for each step and for the total job.

DIRECT MAIL ESTIMATE

6. Are these estimates realistic? Which steps do you think might take a longer time? Calculate any increased cost.

7. Which steps could be done in a shorter time? Calculate the amount of money saved.

JOB ESTIMATES

Based on an overhead rate of $20 per hour fill in the chart below for a job involving 5,000 pieces.

Function	Pieces/Hour	Cost per Piece	Total Charge
Open envelope	1,700/hour		
Fold invitation	350/hour		
Labeling	500/hour		
1 PC insert	400/hour		
Shipping	1,700/hour		

❶ Have any parts of the job been left out of this estimate?

❷ Are the time estimates reasonable? Could anything be done faster? Does anything need more time?

JOB ESTIMATES

Job Description

100,00 counter cards 7 1/8 X 9 1/4 2 1/2 inches thick
packed 350 to a carton

50,000 pads 50 sheets per pad
packed 80 per carton

- Stick cards to pads (2 per pad)
- Place 20 units in a carton

Receive and set up:	3 skids per hour
Assembly:	45 units per hour
Packing:	25 cartons per hour
Assume overhead of $20 per hour	

1. Make a list of all the different type of workers you will need to do this job.

2. Calculate the total man hours required for receiving and set up; for assembly; for packing.

3. Calculate the cost per piece for set up; for assembly; for packing. Calculate the total cost for each based on the cost per piece.

4. In how many days, with how many people could you get the job done? (list several different possibilities)

POST-TEST

1. Express the following fraction as an equivalent fractions as indicated.

$$\frac{5}{8} = \frac{\quad}{64}$$

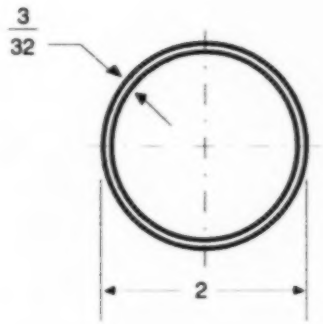
2. Express the following improper fraction as a mixed number:

$$\frac{21}{5} = \underline{\qquad\qquad}$$

3. Express the following fraction as a fraction in lowest terms

$$\frac{18}{64} = \underline{\qquad\qquad}$$

4. Find the inside diameter:



POST-TEST

5. Write each of the following numbers as words.

   - 0.74 _____
   - 0.008 _____

6. Write each of the following numbers to the indicated number of decimal places.

   - twenty-six hundredths _____
   - five and eighty-one thousandths _____

7. Round each of the following numbers to the indicated number of decimal places.

   - 5.0467 (hundredths) _____
   - 7.1127 (thousandths) _____

8. Change the following measurements to inches:

   - .8 foot _____
   - 2.5 feet _____

9. Add the following values

   5 + 0.92 + 0.5034 = _____

POST-TEST

10. Multiply or divide the following values. Round the answer to the hundredths place where necessary.

- 3.63 x 2.30 = _____
- 0.85 ÷ 0.39 = _____

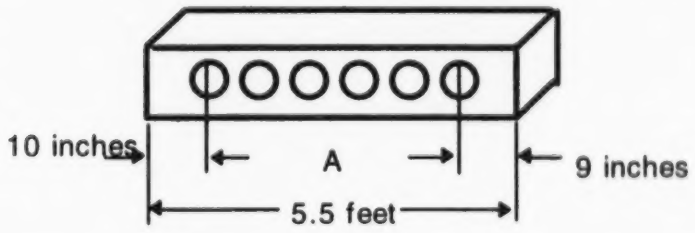
11. Find the decimal or fraction equivalents of each of the following numbers using the decimal equivalent table.

- $\frac{18}{32}$ = _____
- 0.6563 = _____

12. Determine the decimal equivalents of each of the following decimals without using the decimal equivalent table.

- $\frac{7}{12}$ = _____
- $\frac{13}{60}$ = _____

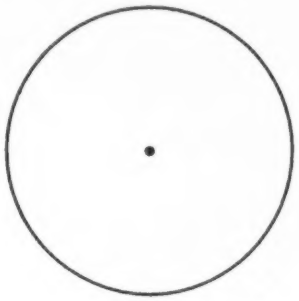
13. Holes are to be drilled in the length of angle iron as shown. Find distance A.



_____

POST TEST

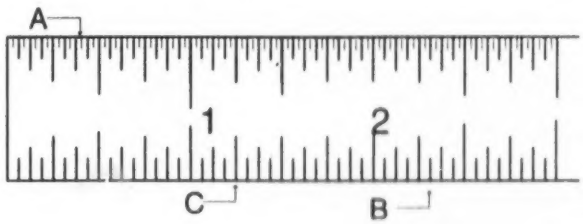
14. Using a ruler, find the diameter and radius of the circle drawn.



Diameter _____

Radius _____

15. Read the measurements A-C on the graduated fractional rule shown.



A. _____

B. _____

C. _____

POSTTEST

16. You are assembling 15 units. The work order calls for 4.25 feet of wire per unit. How much wire do you need altogether? (feet and inches)

_____

17. Would wire be measured in units of square feet?

_____

18. How many minutes is .3 of an hour?

_____